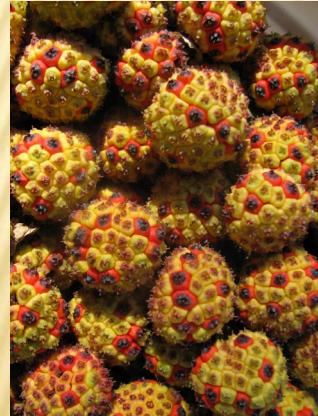


Reproductive Biology

Why is it Important ?

Dave Kolotelo

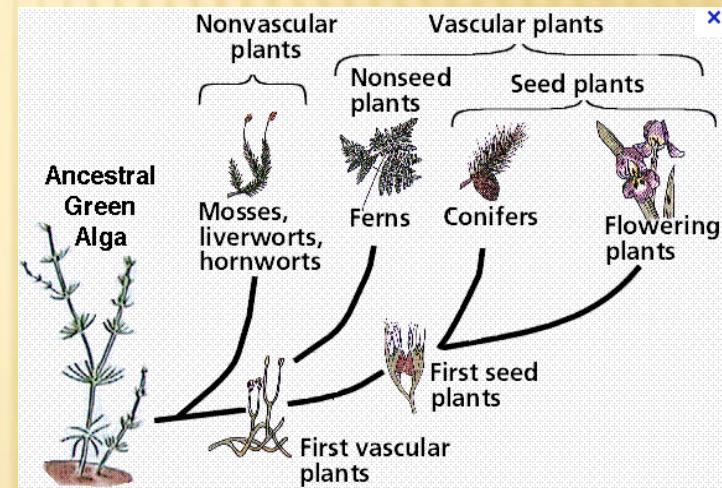
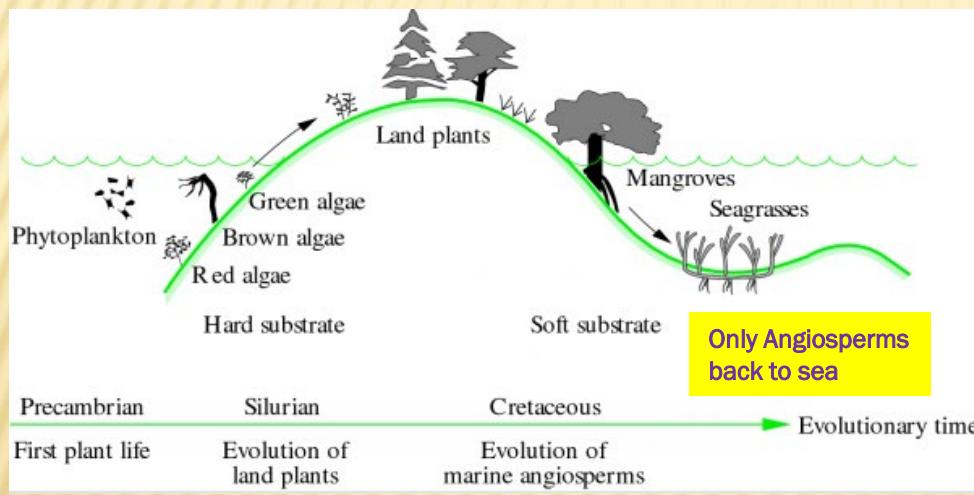


If you know your history
Then you would know
where you're coming from



IN THE BEGINNING....

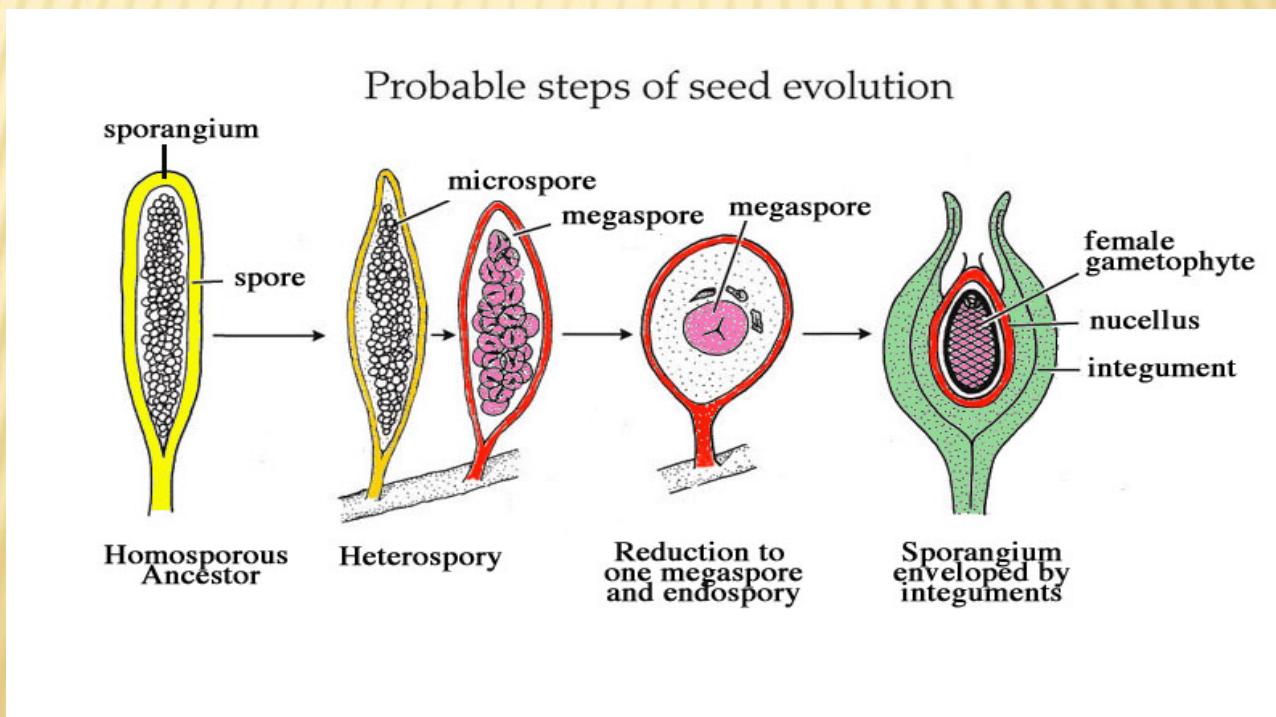
- ✖ 450 (500) MYA first land plants appear
- ✖ Mycorrhizal associations appeared concurrently
- ✖ Early land plants reproduced like ferns (spores requiring H₂O)



- ✖ Xylem evolved prior to seeds (tree-like ferns) moist climate
 - ✚ Xylem anatomy reduces potential for freeze or drought induced embolism
 - ✚ Allows for expansion into stressful environments in addition to Mycorrhizae

SEED EVOLUTION

- × Heterospory – separate ‘male’ and ‘female’ spores
- × Megaspore Reduction / retention in sporophyte
- × Integument Evolution – protection
- × +"Pollen Reception mechanisms".... Water ‘independence’



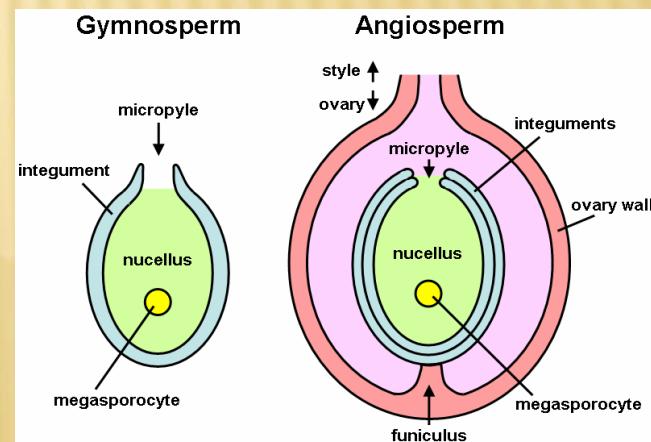
WHY SEEDS??

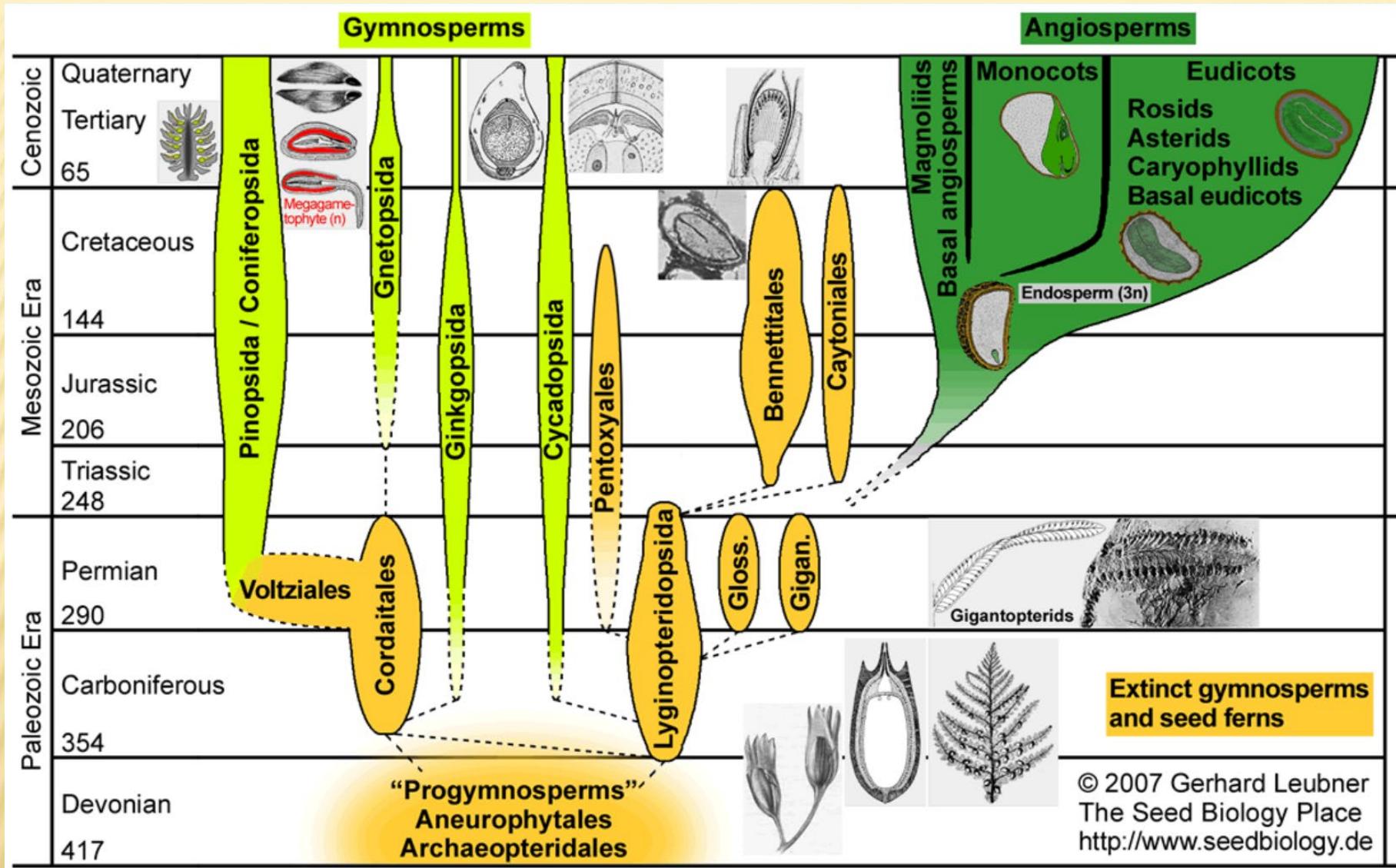


- ✖ “Concentrated Life” – embryo, food, protection
- ✖ Isolation from external environment
 - + Protection from dessication / direct ‘feeding’
 - + Evolution of Seed Dormancy
 - avoid unfavourable conditions / many different triggers (cold, smoke, pH ..)

✖ Dispersal Package

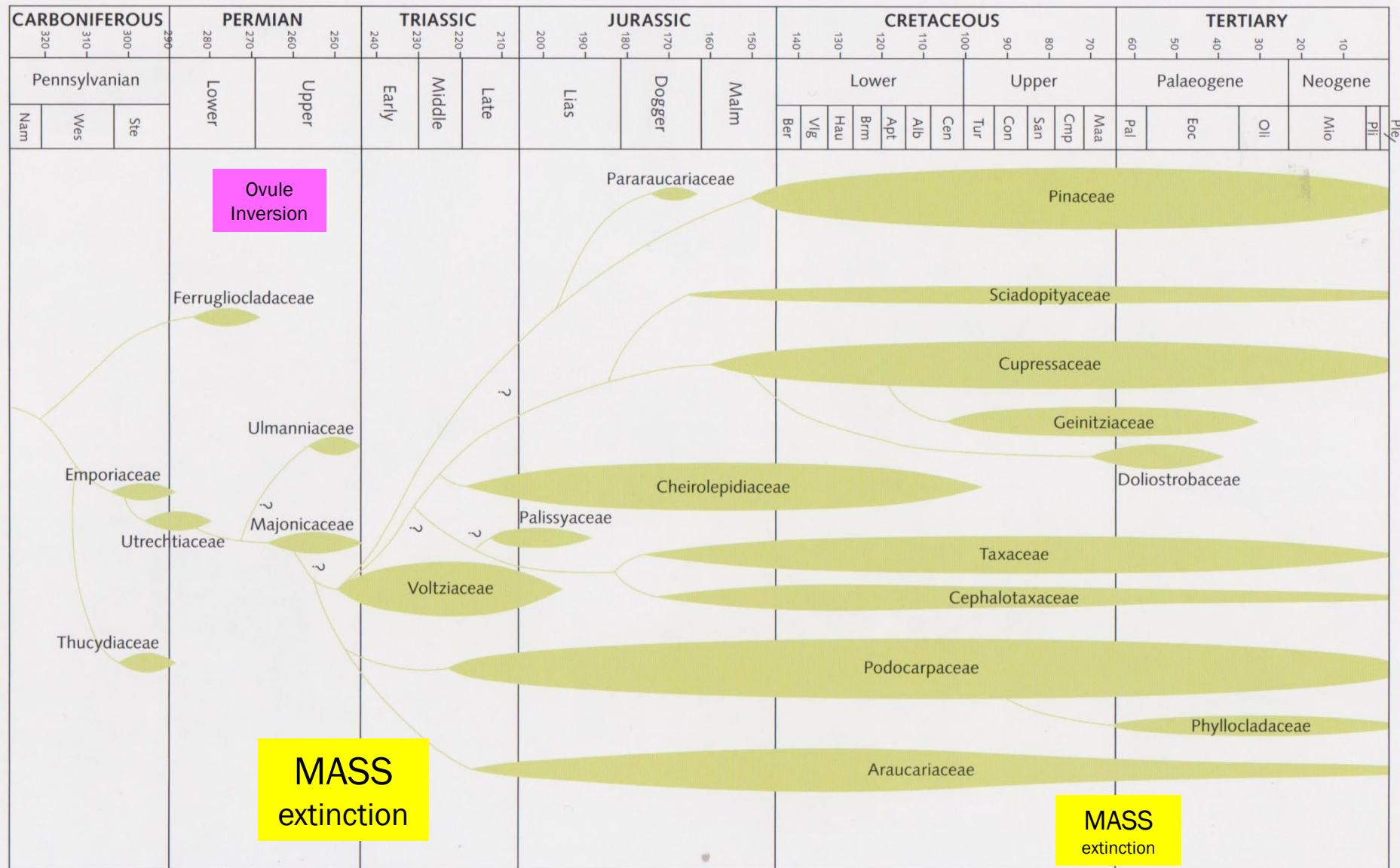
- ✖ Two main types of seed plants
 - + Gymnosperms (“naked” / 1n vs. 3n) ≈627 sp.
 - + Angiosperms ≈250 000 sp.
- + Divergence about 310 MYA





Dinosaurs of the Plant Kingdom

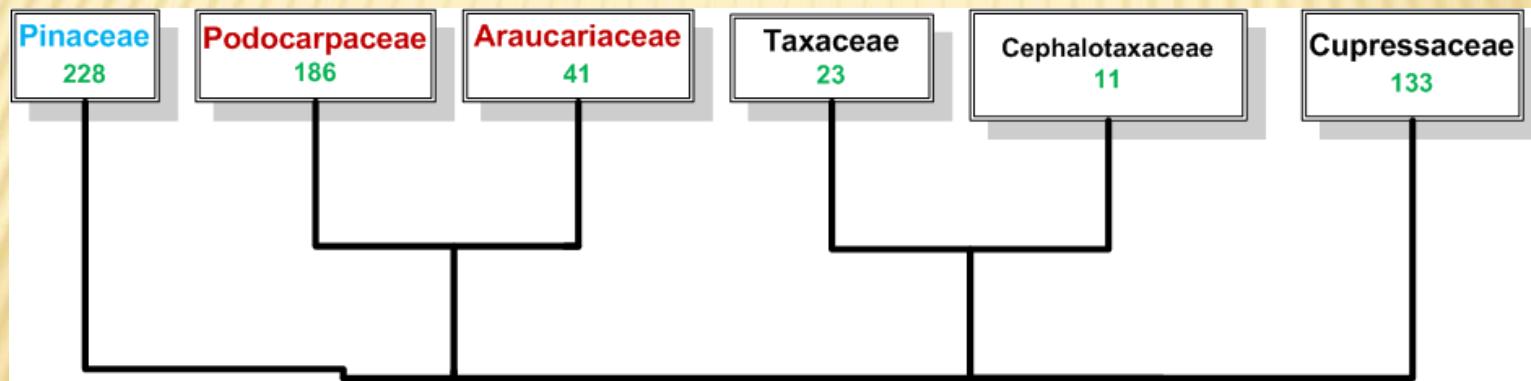
FOCUS ON CONIFERS - from FARJON 2008



CONTINENT SEPARATION



- ✗ Pangea (supercontinent) divides into Laurasia (N) and Godwana (S) ≈ 200 MYA
- ✗ Conifer Diversification and isolation – 8 families, 70 genera, 627 species



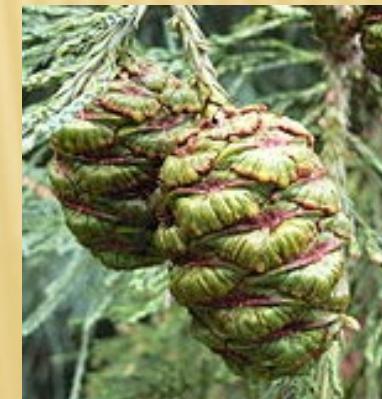
- ✗ Cupressaceae 160 MYA
 - ✗ One third of all conifers in these genera:
- Pinaceae 150 MYA
- Pinus (109 sp.) (Northern hemisphere) **Monoecious**
Podocarpus (Southern hemisphere) **Dioecious**



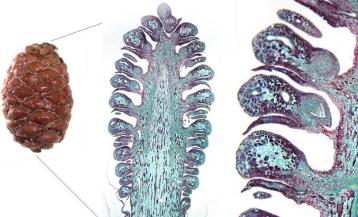
Main BC genera – apologies to Taxaceae (fleshy ovuliferous structures)

	Bract / scale complex	Seed Wings	Phyllotaxis	Resin vesicles	Serotiny Occurs
Pinaceae 11 genera	Each identifiable	From ovuliferous scale	Alternate Fibonacci Rules !	Abies Tsuga	Pinus Picea
Cupressaceae 30 genera	Fused	From ovule Integument Dewinging	Opposite (mostly)	Thuja Cedrus, Pseudolarix Keteleeria, Nothotsuga	Actinostrobus, Callitris, Cupressus, Tetraclinis, Widdringtonia, Sequoiadendron

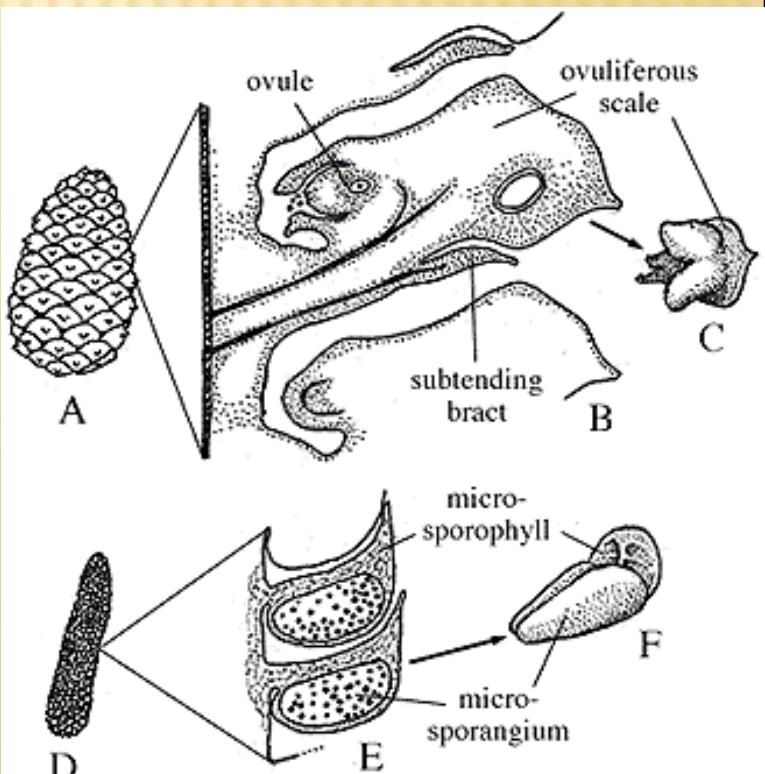
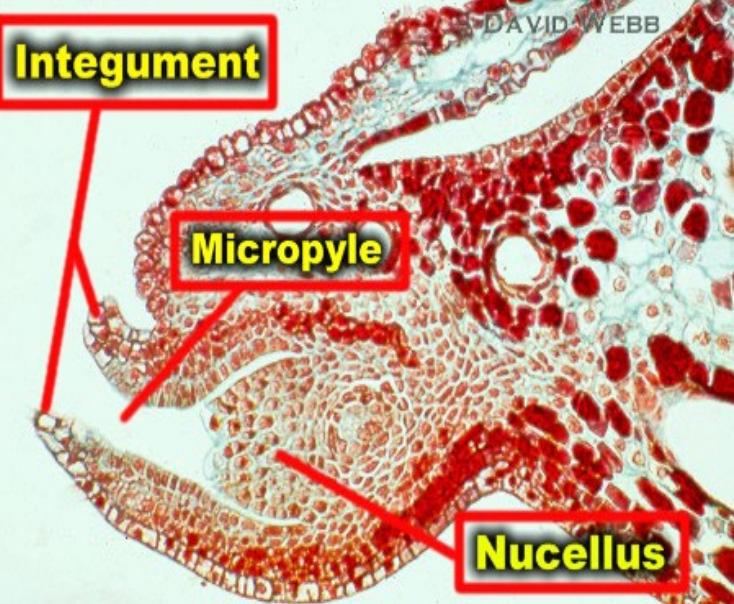
It appears as if cone serotiny and presence of resin vesicles in the seed coat have developed independently in the two families and probably with species in the various genera



“CONES”



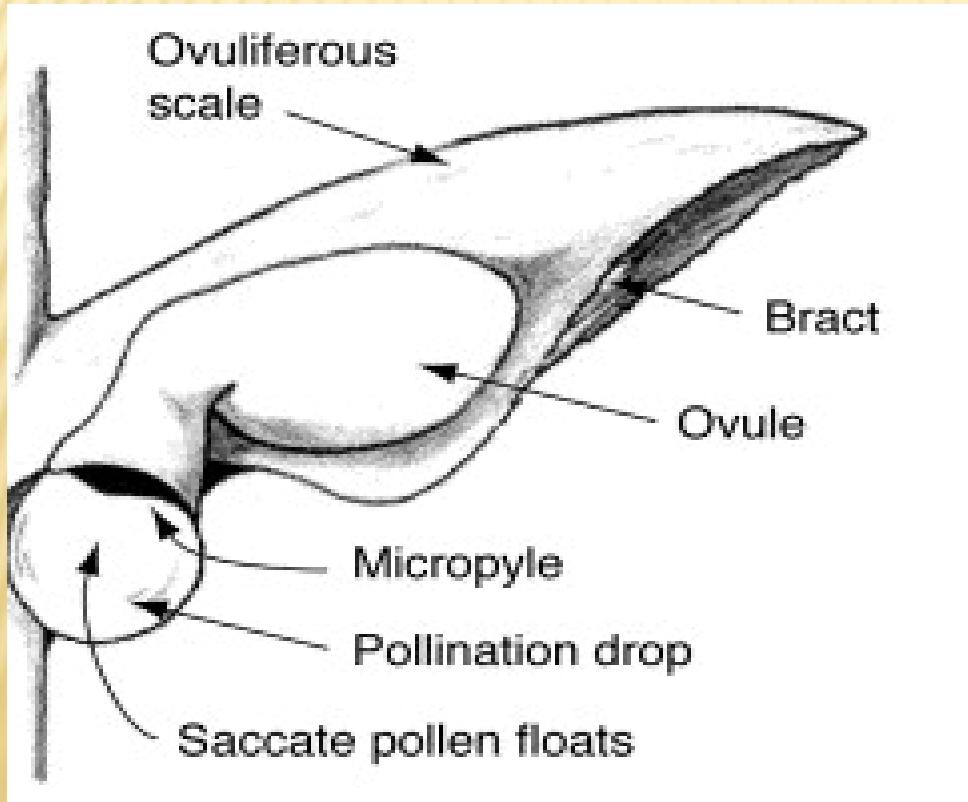
- ✖ Structures that house ovules, allow pollen to enter and then close to protect embryo
- ✖ Bract – scale complex diversity
- ✖ Seed cones are compound = modified shoot
- ✖ Large diversification among genera
- ✖ Pollen cones are simple = modified leaf
- ✖ Very little diversification



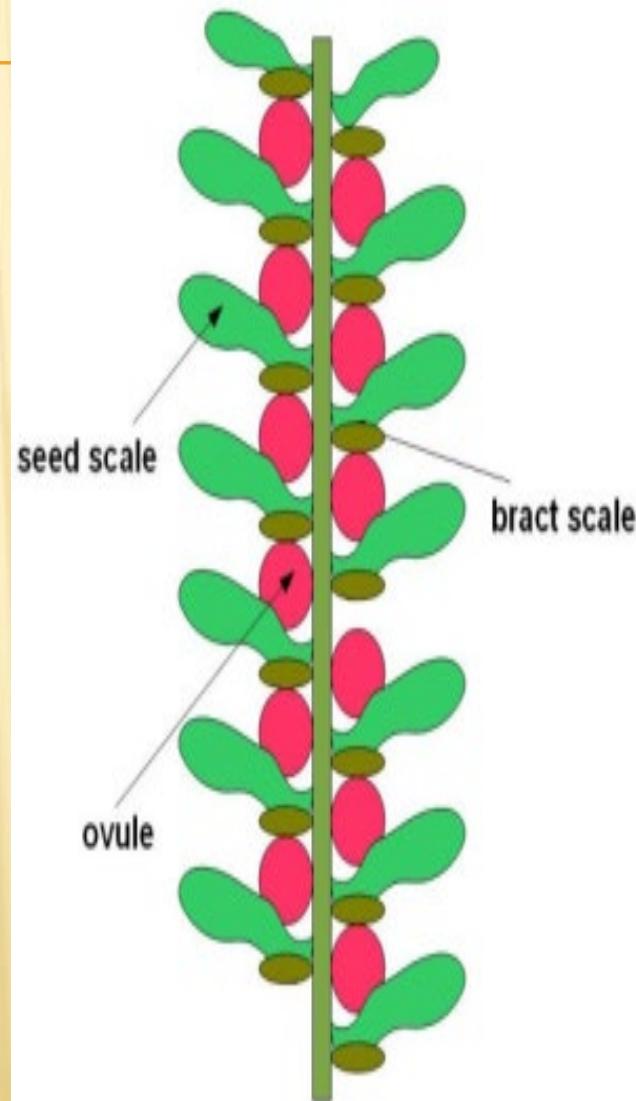
OVULE INVERSION

≈ 265 MYA ?

- Micropyle points towards cone axis
- Micropyle may point up or down depending on pollen type
- Position allows for seed wing evolution

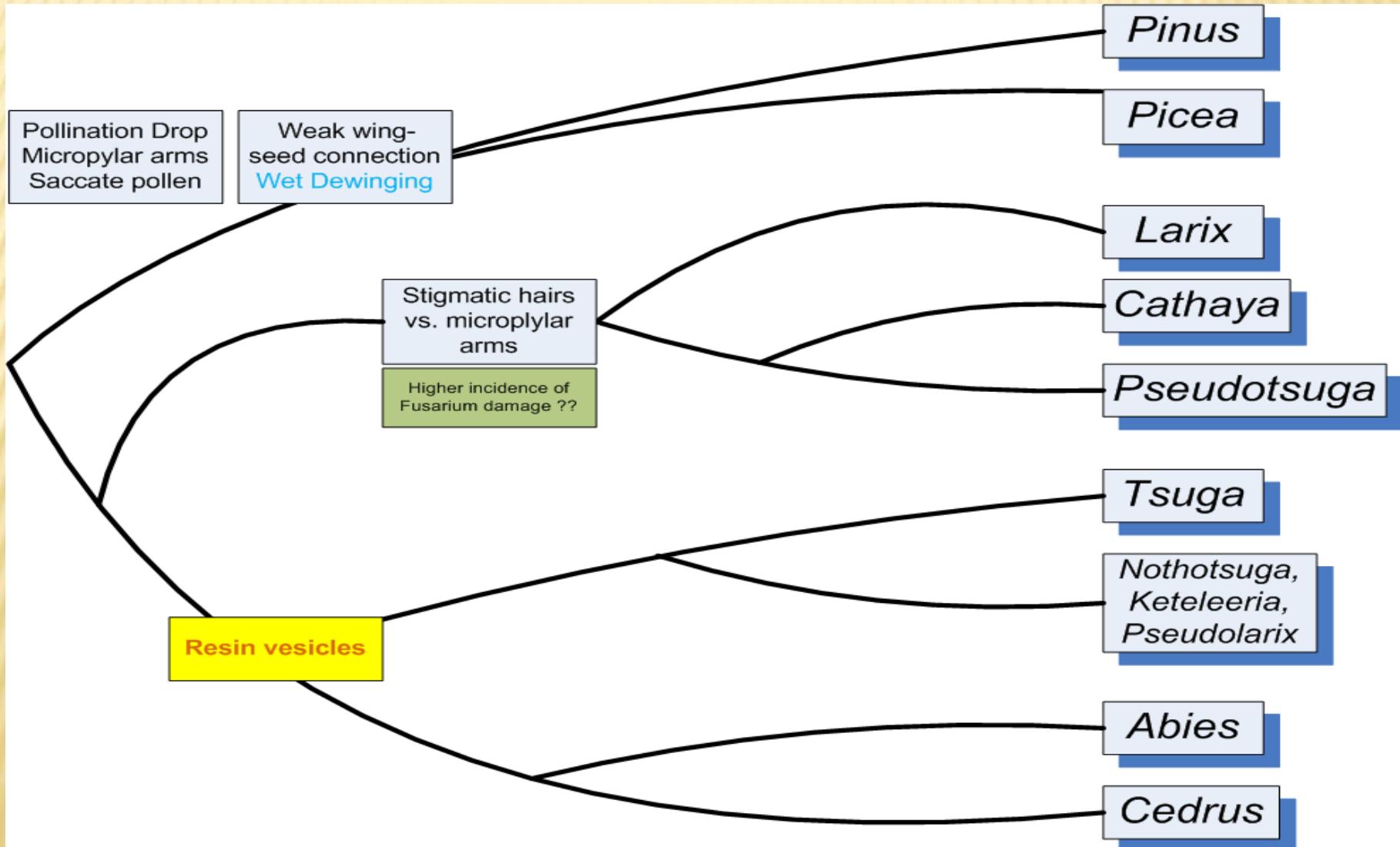


Schematic structure of a ripe female conifer cone



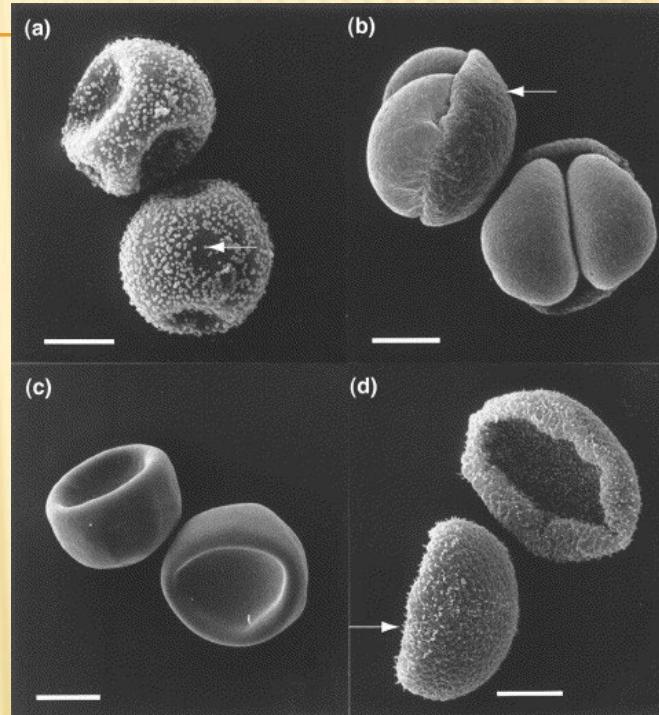
© by FerroMetall

PINACEAE GENERA RELATIONSHIPS

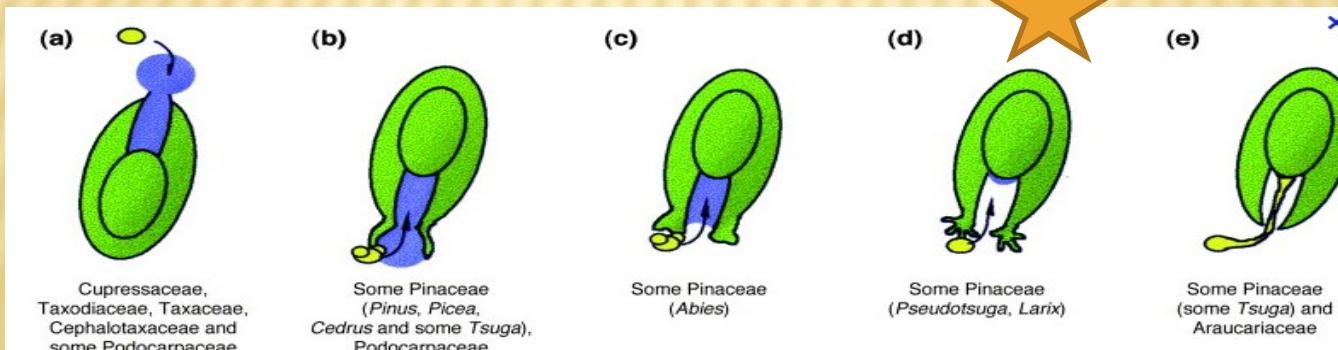


HOLY TRINITY OF CONIFER POLLINATION

- ✖ Ovule orientation
- ✖ Pollen type (saccate, armoured...)
- ✖ Ovular secretion mechanism
 - + Pollination drop
 - + Delayed secretion
 - + Never
- ✖ Where does pollen germinate?



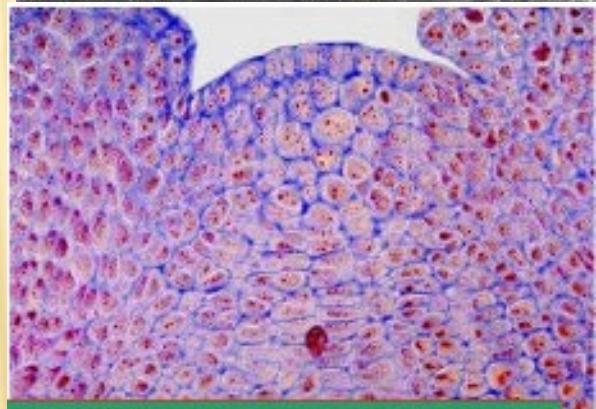
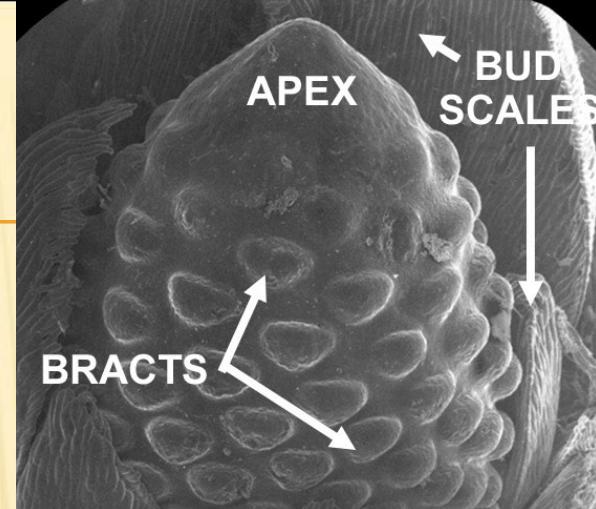
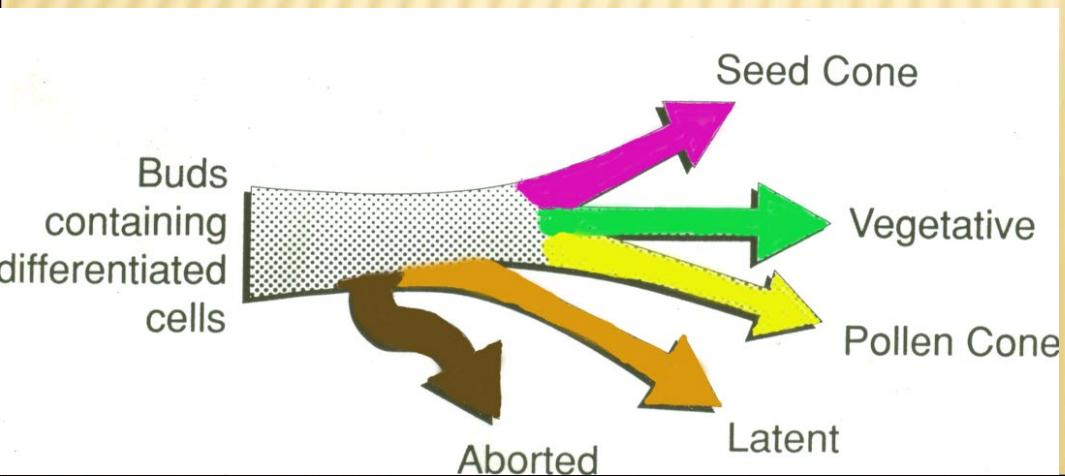
- a) Yellow cypress
- b) *Pinus*
- c) *Pseudotsuga*
- d) *Tsuga heterophylla*



From Owens et al 1998

It all starts in the Apices

- ✖ Primordia for next years structures are 'differentiating' within developing buds
- ✖ Shoot position & vigour, tree vigour, and climate will impact primordia fate
- ✖ What are we learning today about reproductive biology to increase cone production
 - + Do we know it all?
 - + Impacts of climate change – everything else seem fair game to study?



Conifers

